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UTILITY PATENT APPLICATION TRANSMITTAL <i>(Only for new nonprovisional applications under 37 C.F.R. § 1.53(b))</i>	Attorney Docket No.	679P01US
	First Inventor or Application Identifier	S. Dell'Aera
	Title	Radio Calibration by Correcting the Crystal Frequency
	Express Mail Label No.	

APPLICATION ELEMENTS <i>See MPEP chapter 600 concerning utility patent application contents.</i>	ADDRESS TO: Assistant Commissioner for Patents Box Patent Application Washington, DC 20231
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1. <input checked="" type="checkbox"/> * Fee Transmittal Form (e.g., PTO/SB/17) <i>(Submit an original and a duplicate for fee processing)</i>	5. <input type="checkbox"/> Microfiche Computer Program (Appendix)
2. <input checked="" type="checkbox"/> Specification [Total Pages 18] <i>(preferred arrangement set forth below)</i> <ul style="list-style-type: none"> - Descriptive title of the invention - Cross References to Related Applications - Statement Regarding Fed sponsored R & D - Reference to Microfiche Appendix - Background of the invention - Brief Summary of the invention - Brief Description of the Drawings (if filed) - Detailed Description - Claim(s) - Abstract of the Disclosure 	6. Nucleotide and/or Amino Acid Sequence Submission <i>(if applicable, all necessary)</i> <ul style="list-style-type: none"> a. <input type="checkbox"/> Computer Readable Copy b. <input type="checkbox"/> Paper Copy (identical to computer copy) c. <input type="checkbox"/> Statement verifying identity of above copies
3. <input checked="" type="checkbox"/> Drawing(s) (35 U.S.C. 113) [Total Sheets 5]	ACCOMPANYING APPLICATION PARTS
4. Oath or Declaration [Total Pages 2] <ul style="list-style-type: none"> a. <input type="checkbox"/> Newly executed (original or copy) b. <input type="checkbox"/> Copy from a prior application (37 C.F.R. § 1.63(d)) <i>(for continuation/divisional with Box 16 completed)</i> <ul style="list-style-type: none"> i. <input type="checkbox"/> DELETION OF INVENTOR(S) Signed statement attached deleting inventor(s) named in the prior application, see 37 C.F.R. §§ 1.63(d)(2) and 1.33(b). 	
15. Other: _____	

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16. If a CONTINUING APPLICATION, check appropriate box, and supply the requisite information below and in a preliminary amendment:

☐ Continuation ☐ Divisional ☐ Continuation-in-part (CIP) of prior application No: _____

Prior application information: Examiner _____ Group / Art Unit: _____

For CONTINUATION or DIVISIONAL APPS only: The entire disclosure of the prior application, from which an oath or declaration is supplied under Box 4b, is considered a part of the disclosure of the accompanying continuation or divisional application and is hereby incorporated by reference. The incorporation can only be relied upon when a portion has been inadvertently omitted from the submitted application parts.

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Name	Pascal & Associates				
Address	P.O. Box 3440				
	Station D				
City	Ottawa	State	Ontario	Zip Code	K1P 6P2
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Signature		Date	Oct 31/00

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See 37 C.F.R. §§ 1.27 and 1.28.

Complete if Known

Application Number	unknown
Filing Date	on even date
First Named Inventor	S. Dell'Aera
Examiner Name	
Group / Art Unit	
Attorney Docket No.	679P01US

TOTAL AMOUNT OF PAYMENT (\$)

METHOD OF PAYMENT (check one)

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2. ☒ Payment Enclosed:

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FEE CALCULATION

1. BASIC FILING FEE

Large Entity Fee Code (\$)	Small Entity Fee Code (\$)	Fee Description	Fee Paid
101 690	201 345	Utility filing fee	710.
106 310	206 155	Design filing fee	
107 480	207 240	Plant filing fee	
108 690	208 345	Reissue filing fee	
114 150	214 75	Provisional filing fee	

SUBTOTAL (1) (\$710.)

2. EXTRA CLAIM FEES

Total Claims: 15 - 20** = 5 X Fee from below =

Independent Claims: 3 - 3** = 0 X Fee from below =

Multiple Dependent: 0 X Fee from below =

**or number previously paid, if greater; For Reissues, see below

Large Entity Fee Code (\$)	Small Entity Fee Code (\$)	Fee Description	Fee Paid
103 18	203 9	Claims in excess of 20	
102 78	202 39	Independent claims in excess of 3	
104 260	204 130	Multiple dependent claim, if not paid	
109 78	209 39	** Reissue independent claims over original patent	
110 18	210 9	** Reissue claims in excess of 20 and over original patent	

SUBTOTAL (2) (\$)

FEE CALCULATION (continued)

3. ADDITIONAL FEES

Large Entity Fee Code (\$)	Small Entity Fee Code (\$)	Fee Description	Fee Paid
105 130	205 65	Surcharge - late filing fee or oath	
127 50	227 25	Surcharge - late provisional filing fee or cover sheet.	
139 130	139 130	Non-English specification	
147 2,520	147 2,520	For filing a request for reexamination	
112 920*	112 920*	Requesting publication of SIR prior to Examiner action	
113 1,840*	113 1,840*	Requesting publication of SIR after Examiner action	
115 110	215 55	Extension for reply within first month	
116 380	216 190	Extension for reply within second month	
117 870	217 435	Extension for reply within third month	
118 1,360	218 680	Extension for reply within fourth month	
128 1,850	228 925	Extension for reply within fifth month	
119 300	219 150	Notice of Appeal	
120 300	220 150	Filing a brief in support of an appeal	
121 260	221 130	Request for oral hearing	
138 1,510	138 1,510	Petition to institute a public use proceeding	
140 110	240 55	Petition to revive - unavoidable	
141 1,210	241 605	Petition to revive - unintentional	
142 1,210	242 605	Utility issue fee (or reissue)	
143 430	243 215	Design issue fee	
144 580	244 290	Plant issue fee	
122 130	122 130	Petitions to the Commissioner	
123 50	123 50	Petitions related to provisional applications	
126 240	126 240	Submission of Information Disclosure Stmt	
581 40	581 40	Recording each patent assignment per property (times number of properties)	
146 690	246 345	Filing a submission after final rejection (37 CFR § 1.129(a))	
149 690	249 345	For each additional invention to be examined (37 CFR § 1.129(b))	

Other fee (specify) _____

Other fee (specify) _____

SUBTOTAL (3) (\$)

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SUBMITTED BY		Complete (if applicable)	
Name (Print/Type)	Harold C. Baker	Registration No. (Attorney/Agent)	19333
Signature		Telephone	613 820-1366
		Date	Oct 31/00

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RADIO CALIBRATION BY CORRECTING THE CRYSTAL FREQUENCY

FIELD OF THE INVENTION:

5 This invention relates to radios and crystals used in radio. Specifically, the invention relates to methods and devices used to calibrate radio crystals and to correct for errors in the crystal frequency or errors due to Doppler effects.

BACKGROUND TO THE INVENTION:

10 Modern equipment which use radio waves for communications, such as cellular telephones, generally operate at very high frequencies. These devices use frequency synthesizers to produce the high frequencies required. However, crystals are still needed for the high stability frequency they produce. Frequency synthesizers, such as phase locked loop (PLL) frequency synthesizers phase lock with the highly stable signals of crystals to produce stable high frequency signals.

15
20 Essentially, frequency synthesizers, especially PLL frequency synthesizers, phase lock with a crystal signal and multiplies the frequency of that crystal signal to produce a utilizable high frequency stable signal. Thus, the high frequency signal used by the radio equipment is a multiple of the crystal frequency.
25 It should be noted that the multipliers used by frequency synthesizers are not limited to integers. Fractional-N frequency synthesizers can use fractional numbers as multipliers. This feature allows highly accurate frequencies to be produced.

30 During production, radios have to be tuned to perform at expected frequencies. However, tuning radios to the proper frequency can be time consuming and expensive. Frequently, radios have a tunable component

which is adjusted to obtain the correct frequency by a technician during production.

One problem with crystals is that, under certain conditions, the frequency of their signals tend to drift away from the expected frequency. The phase of the crystal signal is still stable; however, the frequency may now be different. Temperature, age of the crystal, and other known factors can cause this unfortunate phenomenon. When this occurs, given that the high frequency signal generated by the frequency synthesizer is a multiple of the crystal frequency, the high frequency signal drifts as well. This can lead to poor transmission and/or reception between radios as the frequency being used is no longer the desired frequency. To remedy this problem, periodic calibration of radios is performed. This entails adjusting the crystal frequency to obtain the correct high frequency signal. Clearly, such methods can be expensive, requiring time consuming disassembly of radios and shop time for technicians to perform the calibration.

Another measure currently in use to compensate for frequency drift in crystals is the use of Voltage Controlled Temperature Compensated Crystal Oscillator (VCTCXO). Using a VCTCXO, the new frequency after drift is determined to be higher or lower than the desired frequency. After this determination, a correction voltage is sent to the VCTCXO to compensate for the drift. However, for the most part, radio manufacturers allow their crystals to drift without correction or compensation. To minimize the possibility of such drifts, manufacturers can use more expensive crystals which are either less prone to drift or which do not drift as much.

Another problem with radios concerns the well

known and well documented Doppler effect. Given two communicating radios, with at least one radio in motion relative to the other, the transmission frequency perceived by either radio from the other is constantly changing. This frequency varies as the velocity between the two radios changes. Clearly, the changing frequency perceived by either of the two radios makes for problematic transmissions.

What is therefore needed is a method and an apparatus that allows for fast and inexpensive calibrations of radios. Also needed is a method which compensates for Doppler effects.

SUMMARY OF THE INVENTION:

The present invention provides a simple and inexpensive method of calibrating radios. By implementing the invention in a lab or production facility, quick, automatic calibrations are possible. Furthermore, the invention allows for automatic calibrations and corrections for crystal drift without extensive shop time or technician time.

The present invention automatically corrects for crystal frequency drift by determining the true crystal frequency. Once the true crystal frequency has been measured and calculated, the proper multiplier required to produce a desired frequency can easily be found and implemented. The present invention allows for a constantly changing desired frequency without recalibration and without readjusting the crystal frequency once the true crystal frequency is known. Once the true crystal frequency is found, a proper multiplier can be calculated to produce the desired frequency, what ever that may be. Continuously adjusting the multiplier thus allows for a changing

desired frequency, thereby facilitating clear communications between radios, regardless of whether they are in motion or not.

In one embodiment, the present invention provides a method of calibrating a radio having a frequency source which produces a first signal having a first frequency by multiplying a second signal having an original frequency by a multiplier value, the method comprising determining the original frequency, utilizing the original frequency to determine a corrected multiplier value, and producing an output signal having an output frequency approximately equal to a desired frequency by adjusting the multiplier value to the corrected multiplier value.

In another embodiment, the present invention provides a method of adjusting an output frequency of a signal produced by a frequency source, the said frequency source producing the signal by multiplying an input signal having an original frequency by a multiplier value, the method comprising:

- aa) measuring a preliminary frequency of the signal
- ab) adjusting the multiplier value based on the original frequency and a measurement of the preliminary frequency to produce a corrected multiplier value
- ac) outputting a signal having an intermediate frequency based on the corrected multiplier value
- ad) repeating steps aa) to ac) to obtain a final signal with a final frequency such that a difference between the final frequency and the desired frequency is a minimum.

In a third embodiment, the invention provides a device for adjusting an output frequency of a signal produced by a frequency source comprising:

- a frequency source which produces the signal by multiplying:
 - an input signal having an input frequency and
 - a multiplier having a value
- a controller coupled to the frequency source, said controller controlling the value of the multiplier
- a frequency measurement device coupled to the frequency source, said frequency measurement device measuring the output frequency of the signal and producing measurement data relating to the output frequency of the signal

wherein the controller is coupled to receive the measurement data produced by the frequency measurement device.

BRIEF DESCRIPTION OF THE DRAWINGS:

A better understanding of the invention will be obtained by considering the detailed description below, with reference to the following drawings, in which:

Figure 1 is a block diagram illustrating the main components of a hardware implementation of the invention;

Figure 2 is a flow chart detailing the different steps of one embodiment of the invention;

Figure 3 is a flow chart detailing the different steps of a second embodiment of the invention;

Figure 4 is a flow chart detailing the different steps of a third embodiment of the invention; and

Figure 5 is a more detailed block diagram of a

hardware implementation of the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT:

Referring to Figure 1, a block diagram of a
5 hardware implementation of the invention is illustrated.
A controller 10 is coupled to a frequency source 20
which, in turn, is coupled to a frequency measuring
device 30. The frequency source 20 is controlled by the
controller 10. The controller 10 controls the
10 multiplier by which the frequency source 20 multiplies
the input frequency 40 to produce the output frequency
50.

To determine the input frequency 40, one need
only know the output frequency 50 and control the
15 multiplier supplied by the controller 10. The
controller 10 sets the multiplier to a known value and
uses this known multiplier value so that the frequency
source 20 produces a signal with an output frequency 50.
This signal with the output frequency is accurately
20 measured by the frequency measuring device 30. The
measurement data produced by the frequency measuring
device 30, which is a measurement of the output
frequency 50, is sent to the controller 10. Since the
controller 10 knows the multiplier value used by the
25 frequency source 20 to produce the output frequency 50,
the controller 10 can easily calculate the value of the
input frequency 40. This is done simply by dividing the
value of the output frequency 50 by the known multiplier
value, yielding the true input frequency.

30 Once the true input frequency is known, the
controller can thereby calculate the multiplier value
required by the frequency source 20 to produce a signal
with an output frequency 50 approximately equal to a
desired frequency 60. Once this corrected multiplier

value is found by the controller 10 by dividing the desired frequency the true input frequency, the corrected multiplier is transmitted to the frequency source 20 so that it can be used to produce the desired frequency.

At this point, the radio device utilizing the invention is calibrated as the controller 10 and the frequency source 20 will continue to use the corrected multiplier value until the input frequency 40 or the desired frequency 60 changes. If desired, the true input frequency can be stored in suitable storage means, such as a read only memory (ROM), for future use.

Figure 2 illustrates the logic flow diagram followed by the controller 10 described above.

If the input frequency 40 changes or drifts, perhaps because of the age of a crystal producing the signal with the input frequency 40 or because of temperature effects, the output frequency 50 also changes. This new output frequency 50 is measured by the frequency measuring device 30 and is communicated to the controller 10. The controller 10 then compares the measured new output frequency 50 with the desired frequency 60. If the difference between the desired frequency 60 and the new output frequency 50 is not within preprogrammed tolerances, the controller 10 calculates a new multiplier based on the new output frequency 50. Once this new multiplier value is used by the frequency source 20, the radio device is once again properly calibrated as it produces approximately the desired frequency 60. If the difference between the output frequency 50 and the desired frequency 60 is not within tolerance limits, the calibration starts all over.

Once the difference between the output frequency

50 and the desired frequency 60 is within tolerance limits, the input frequency 40 can now be found. The output frequency 50 is divided by the new multiplier to obtain the input frequency. This input frequency can then be stored in suitable storage means, such as a ROM, for future use.

A logic flow diagram followed by the controller 10 is illustrated in Figure 3.

In another embodiment of the invention, the controller 10 can be used to compensate for a changing desired frequency 60. If, as mentioned above, the radio equipment utilizing the invention is in motion relative to another piece of radio equipment it is communicating with, the output frequency 50 must continually change as the frequency required to communicate with the other piece of radio equipment changes. This means that the desired frequency 60 is constantly changing. When this occurs, the controller 10 must continuously compare the output frequency 50 measured by the frequency measuring device 30 with the changing desired frequency 60. Depending on whether the output frequency 50 is higher or lower than the desired frequency 60, the controller 10 adjusts the multiplier value accordingly. If the output frequency 50 is higher than the desired frequency 60, the multiplier value is lowered from its previous value. Alternatively, if the output frequency 50 is lower than the desired frequency 60, the multiplier value is increased from its previous value.

The amount by which the multiplier value is incremented or decremented can be preprogrammed into the controller. Thus, by having the controller 10 continuously sample, compare, and either increase or decrease the multiplier value, the output frequency 50 approaches the desired frequency 60. This process can

terminate once a final output frequency is found. Such a final output frequency is a frequency that, if not exactly equal to the desired frequency, is within tolerance limits to the desired frequency.

5 The above embodiment can also be used to determine the original or input frequency 40 that was multiplied by a multiplier to synthesize the output frequency 50. Once the final output frequency has been obtained by the above method, the multiplier value used
10 to obtain that final output frequency is noted. The final output frequency is then divided by that multiplier value to determine the original or input frequency 40. This original or input frequency can then be stored in suitable storage means for future use.
15 Once the true original frequency is known, changes in the desired frequency 60 can be accommodated by adjusting the multiplier value.

 The logical flow diagram followed by the controller 10 in implementing the above is shown in
20 Figure 4.

 Alternatively, the controller 10 can be programmed to find the correct multiplier in one iteration of the method. Given a desired frequency 60 and a true input frequency, the controller 10 can skip
25 numerous iterations by simply, as above, dividing the desired frequency 60 by the input frequency 40 to obtain the appropriate multiplier value. While this method may seem more efficient, if the desired frequency 60 is continuously increasing or continuously decreasing,
30 depending again on the Doppler effect, incrementing or decrementing the multiplier value by a set value may be more computationally efficient.

 A more detailed block diagram of a possible embodiment of the invention is pictured in Figure 5. In

5 this embodiment, the frequency source 20 is a high
resolution PLL frequency synthesizer which uses a Delta
Sigma modulator 70. The delta sigma modulator 70 allows
the use of multiplier values having both an integer part
80 and a fractional part 90. Such a frequency source
provides an ideal source for high performance radio
equipment and is ideally suited for this invention. A
Delta-Sigma PLL frequency synthesizer would be ideally
suited for this invention as the Delta-Sigma PLL
10 frequency synthesizer allows for high resolution
multipliers, thereby allowing for a correction of small
errors in the original frequency. However, it should be
noted that any high resolution frequency synthesizer
with a controllable multiplier would be suitable for use
15 in this invention.

It should be noted that the controller 10
referred to above can be implemented using well known
processors. A dedicated microcontroller or a dedicated
general purpose central processing unit can be
20 implemented inside radio equipment to perform the
controller functions. In this case, the software
required to control the logic of the processor would be
resident in a non-volatile memory such as read-only-
memory (ROM) with the true input frequency and the
multiplier value being stored in either a rewritable
25 non-volatile memory such as an electronically erasable
programmable read only memory (E²PROM) or, for a less
expensive implementation, in random access memory (RAM).
However, for mobile applications, where the invention is
resident in a radio, the preferred method of storing the
30 true original frequency is a ROM. In such a case,
moving from one wireless network that uses one frequency
to another that uses another frequency, would only
involve changing the true original frequency by either

replacing the ROM.

In a production facility implementation of the invention, to be used to calibrate mass numbers of radios, the controller 10 could be a general purpose computer such as a personal computer. An appropriate interface between the controller 10, which in this implementation would be external to the radio equipment, allows the controller 10 to send multiplier values to the frequency source 20 resident in the radio equipment. Once the calibration has been completed, the controller can either send the true original or input frequency 40 to the radio or the radio can determine the true original or input frequency 40 from the multiplier value. In this implementation, the frequency measurement device 30 would also be external to the radio equipment.

The frequency measurement device 30, in either an internal radio implementation or a production facility implementation, is a suitable high resolution device. In a production facility, suitable frequency counters or spectrum analyzers can serve as frequency measurement devices. In mobile applications, numerous methods or devices can be used. If a radio base station transmits a reference signal, suitable hardware can determine whether the output frequency of the radio is higher or lower than the reference signal. Obviously, the higher the resolution and the better the accuracy of the frequency measuring device, the more accurate and hence the more useful the invention.

The input frequency can be supplied by a crystal which oscillates at a certain frequency. This option is illustrated in Figure 5.

It should also be noted that the invention can be implemented on a single integrated circuit. All the

components listed above, including the code which runs the controller 10, can be stored on a single application specific integrated circuit (ASIC).

5 A person understanding the above-described invention may now conceive of alternative designs, using the principles described herein. All such designs which fall within the scope of the claims appended hereto are considered to be part of the present invention.

I claim:

1. A method of calibrating a radio having a frequency source which produces a first signal having a first frequency by multiplying a second signal having an original frequency by a multiplier value, the method comprising:

- a) determining the original frequency
- b) utilizing the original frequency to determine a corrected multiplier value
- c) producing an output signal having an output frequency approximately equal to a desired frequency by adjusting the multiplier value to the corrected multiplier value

2. A method as claimed in claim 1 wherein step a) further includes the steps of:

- a1) measuring the first frequency
- a2) dividing the first frequency by the multiplier value to obtain the original frequency.

3. A method as claimed in claim 1 wherein step b) further includes the steps of dividing the desired frequency by the original frequency to obtain the corrected multiplier value.

4. A method as claimed in claim 1 further including

the step of storing the original frequency in storage means.

5. A method as in claim 1 wherein the frequency source is a high resolution frequency synthesizer.

6. A method as in claim 5 wherein the second signal is provided by a crystal oscillating at the original frequency.

7. A method of adjusting an output frequency of a signal produced by a frequency source, said frequency source producing the signal by multiplying an input signal having an original frequency by a multiplier value, the method comprising:

- aa) measuring a preliminary frequency of the signal
- ab) adjusting the multiplier value based on a desired frequency and a measurement of the preliminary frequency to produce a corrected multiplier value
- ac) outputting a signal having an intermediate frequency based on the corrected multiplier value
- ad) repeating steps aa) to ac) to obtain a final signal with a final frequency such that a difference between the final frequency and the desired frequency is a minimum.

8. A method as claimed in claim 7 wherein step ab) further includes a step chosen from the group comprising:

- ab1) incrementing the multiplier value by a preprogrammed value to obtain the corrected multiplier value if the preliminary frequency is lesser than the desired frequency
- ab2) decrementing the multiplier value by a preprogrammed value to obtain the corrected multiplier value if the preliminary frequency is greater than the desired frequency
- ab3) utilizing the multiplier value as the corrected multiplier value if the preliminary frequency is approximately equal to the desired frequency.

9. A method as claimed in claim 7 further including the step of obtaining the original frequency by dividing the final frequency by the corrected multiplier value.

10. A method as claimed in claim 9 further including the step of storing the value of the original frequency in a storage means.

11. A device for adjusting an output frequency of a signal produced by a frequency source, the device comprising:

- a frequency source which produces the signal by multiplying:
 - an input signal having an input frequency and
 - a multiplier having a value
- a controller coupled to the frequency source, said controller controlling the value of the multiplier
- a frequency measurement device coupled to the frequency source, said frequency measurement device producing measurement data relating to the output frequency of the signal

wherein the controller is coupled to receive the measurement data produced by the frequency measurement device.

11. A device as claimed in claim 10 wherein the frequency source is chosen from the group comprising:

- a high resolution frequency synthesizer
- a radio

12. A device as claimed in claim 10 wherein the controller is chosen from the group comprising:

- a general purpose microprocessor
- a microcontroller
- a general purpose personal computer

13. A device as claimed in claim 10 wherein the frequency source, the controller, and the frequency

measurement device are implemented on a single application specific integrated circuit.

14. A device as claimed in claim 10 further including storage means for storing the input frequency.

15. A device as claimed in claim 10 wherein the frequency measurement device measures the output frequency of the signal.

ABSTRACT

The present invention provides a simple and inexpensive method of calibrating radios. The present invention automatically corrects for crystal frequency drift by determining the true crystal frequency. Once the true crystal frequency has been measured and calculated, the proper multiplier required to produce a desired frequency can easily be found and implemented. The present invention allows for a constantly changing desired frequency without recalibration and without readjusting the crystal frequency once the true crystal frequency is known. Once the true crystal frequency is found, a proper multiplier can be calculated to produce the desired frequency. Continuously adjusting the multiplier thus allows for a changing desired frequency, thereby facilitating clear communications between radios, regardless of whether they are in motion or not.

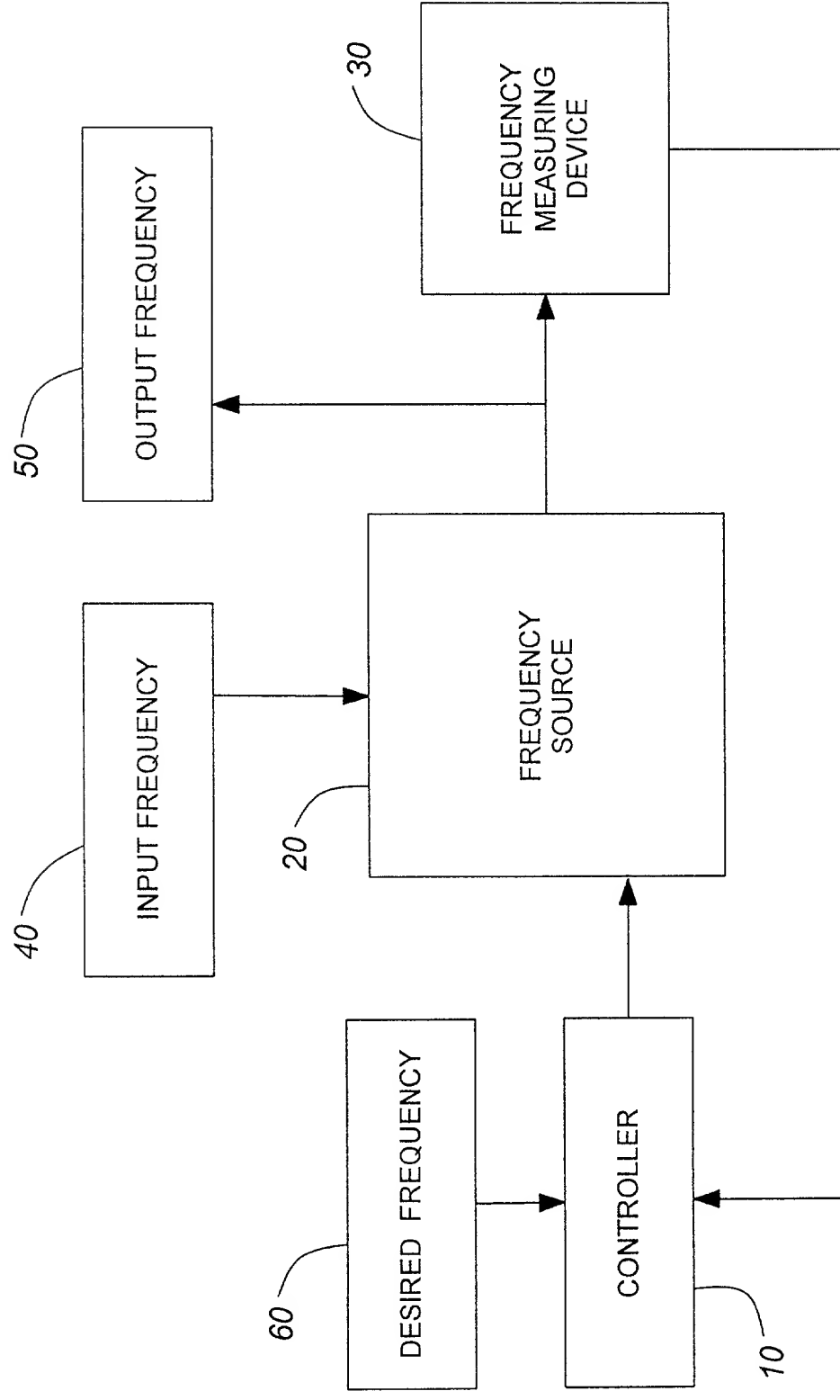


FIG. 1

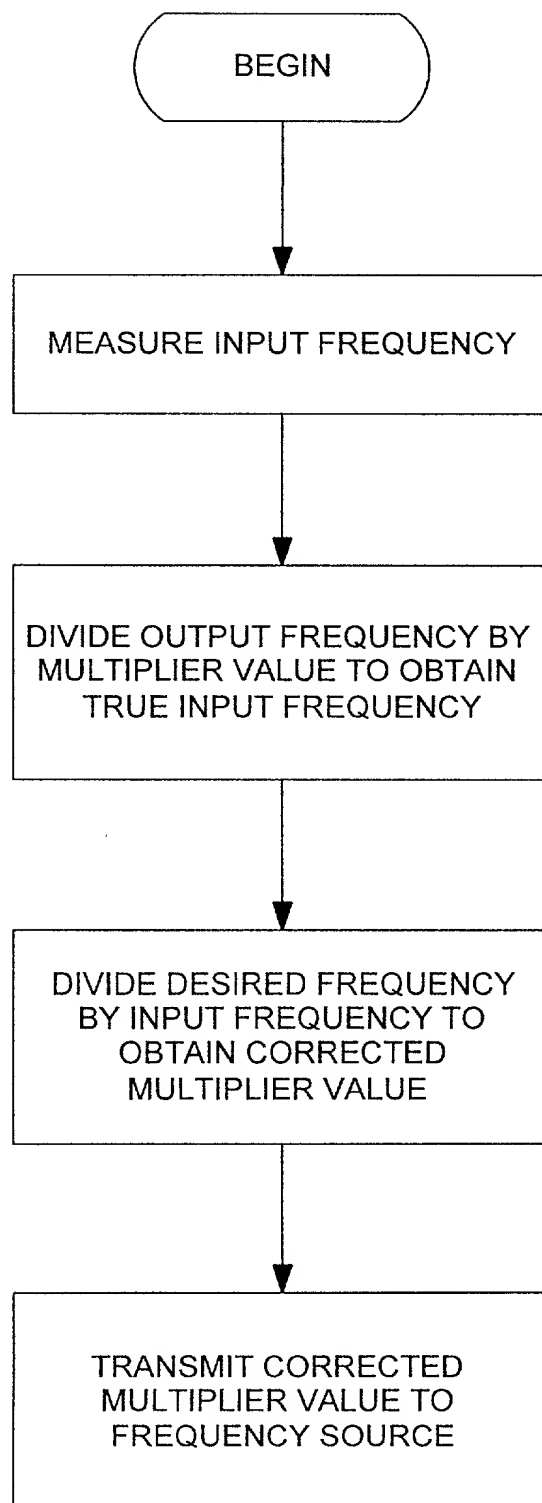


FIG. 2

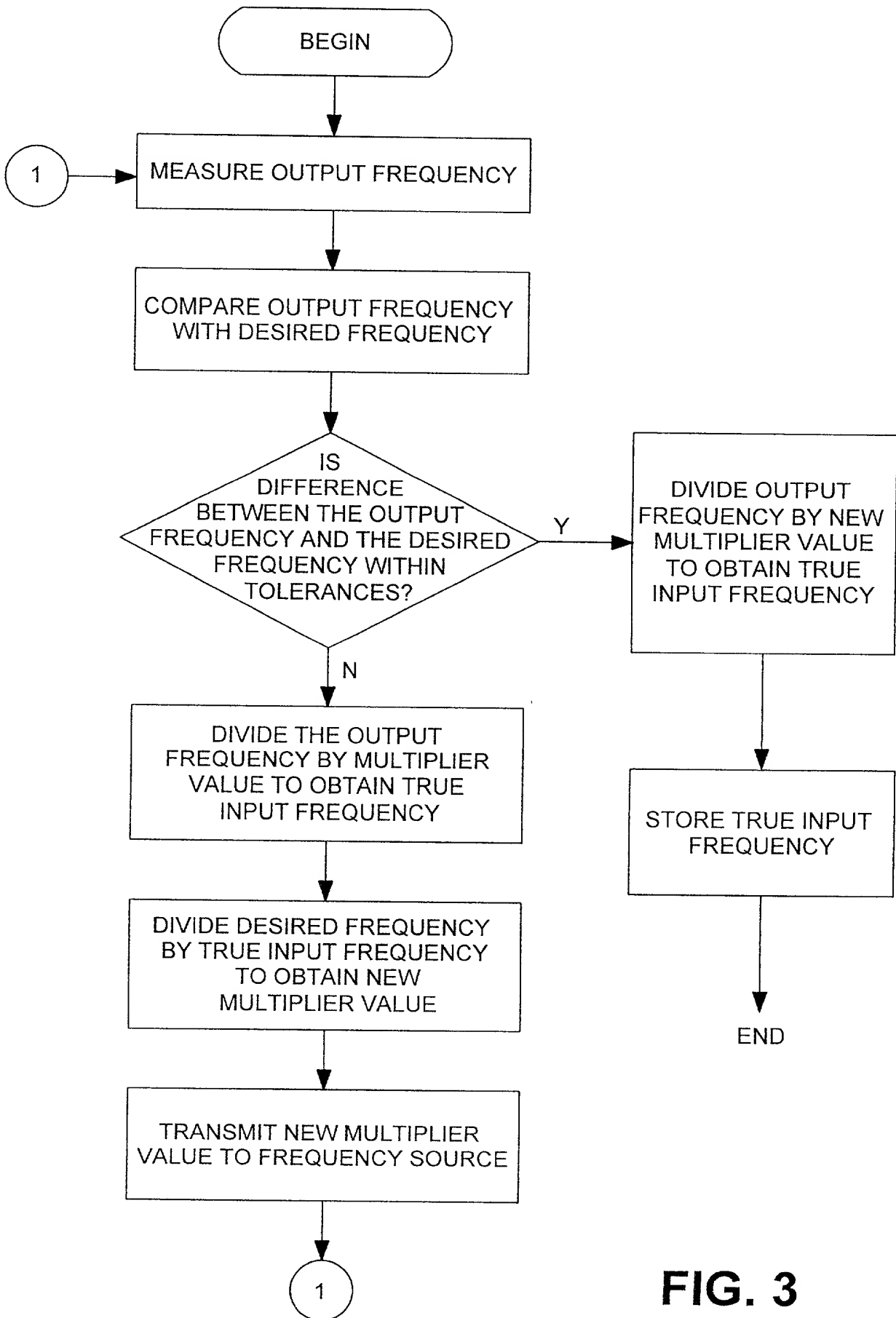


FIG. 3

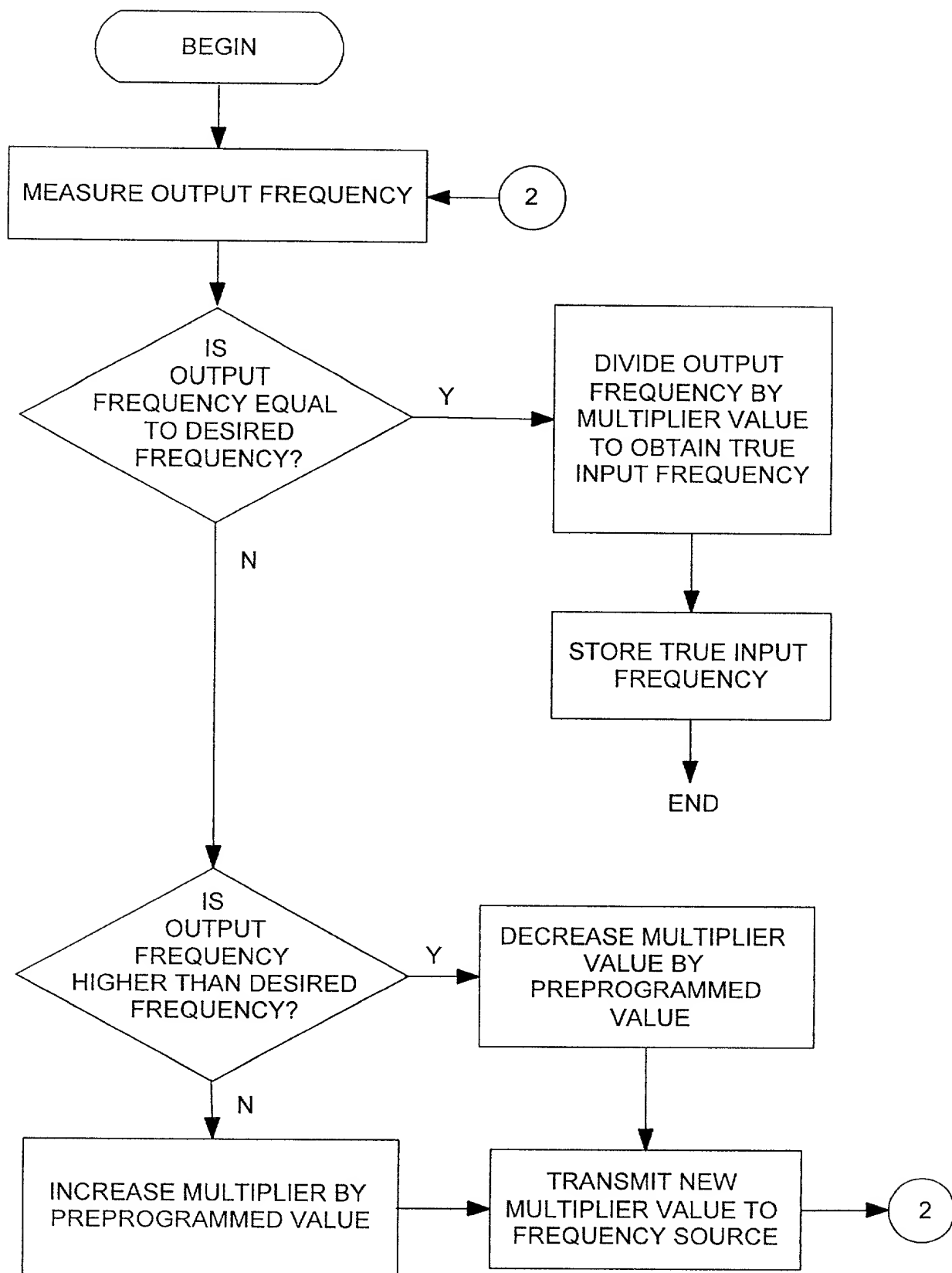
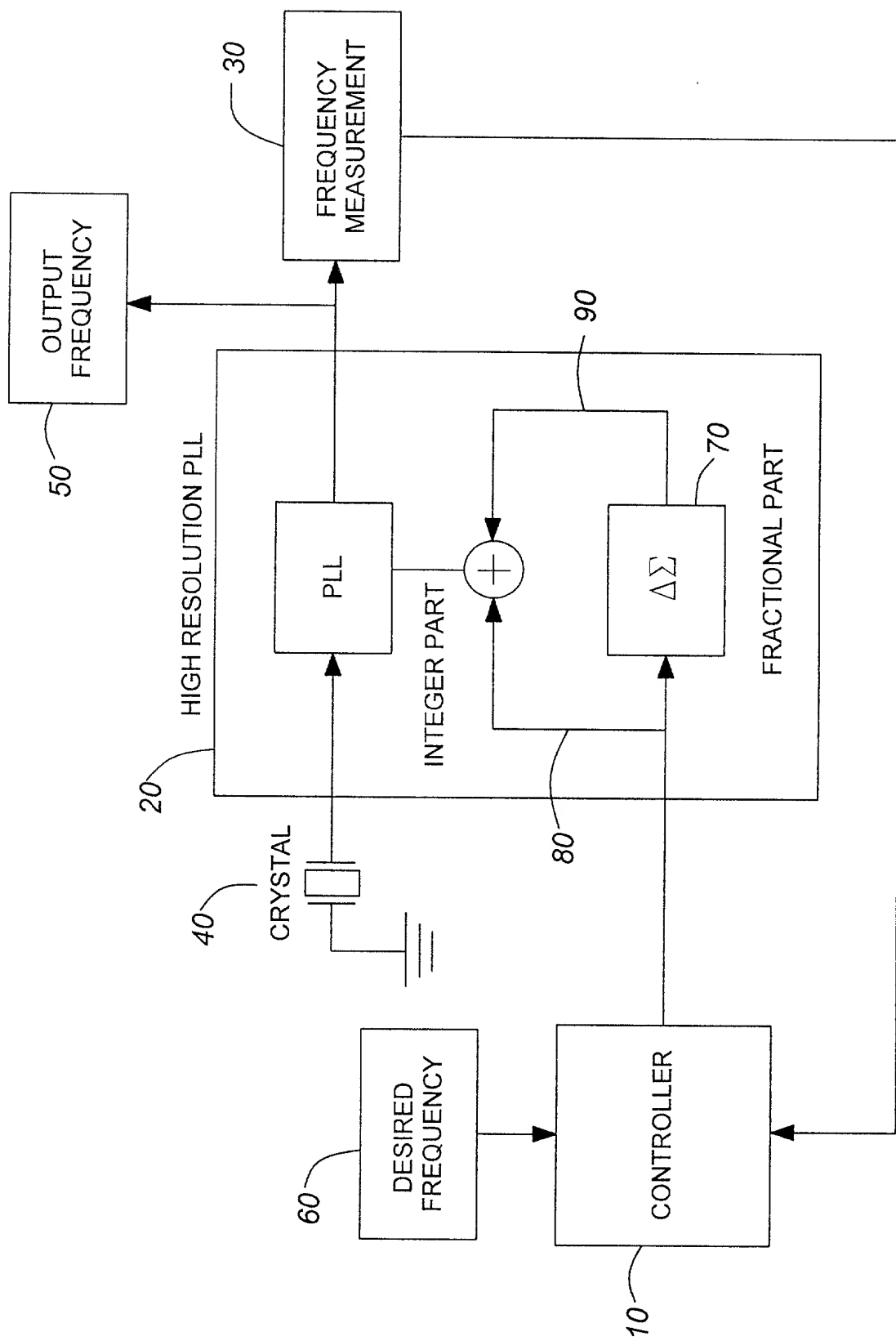


FIG. 4

**FIG. 5**

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PTO/SB/01 (12-97)

Approved for use through 9/30/00. OMB 0651-0032

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DECLARATION FOR UTILITY OR DESIGN PATENT APPLICATION (37 CFR 1.63)	Attorney Docket Number	679P01US	
	First Named Inventor	Della'Aera	
	COMPLETE IF KNOWN		
	Application Number	/	
	Filing Date	on even date	
	Group Art Unit		
<input checked="" type="checkbox"/> Declaration Submitted with Initial Filing	OR	<input type="checkbox"/> Declaration Submitted after Initial Filing (surcharge (37 CFR 1.16 (e)) required)	
		Examiner Name	

As a below named inventor, I hereby declare that:

My residence, post office address, and citizenship are as stated below next to my name.

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

RADIO CALIBRATION BY CORRECTING THE CRYSTAL FREQUENCY

☒ the specification of which (Title of the Invention)
is attached hereto
OR
☐ was filed on (MM/DD/YYYY) as United States Application Number or PCT International
Application Number and was amended on (MM/DD/YYYY) (if applicable).

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment specifically referred to above.

I acknowledge the duty to disclose information which is material to patentability as defined in 37 CFR 1.56.

I hereby claim foreign priority benefits under 35 U.S.C. 119(a)-(d) or 365(b) of any foreign application(s) for patent or inventor's certificate, or 365(a) of any PCT international application which designated at least one country other than the United States of America, listed below and have also identified below, by checking the box, any foreign application for patent or inventor's certificate, or of any PCT international application having a filing date before that of the application on which priority is claimed.

Prior Foreign Application Number(s)	Country	Foreign Filing Date (MM/DD/YYYY)	Priority Not Claimed	Certified Copy Attached?	
				YES	NO
2,288,495	Canada	11/02/1999	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>

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[Page 1 of 2]

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U.S. Parent Application or PCT Parent Number	Parent Filing Date (MM/DD/YYYY)	Parent Patent Number (if applicable)

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As a named inventor, I hereby appoint the following registered practitioner(s) to prosecute this application and to transact all business in the Patent and Trademark Office connected therewith:

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H.C. Baker	19333		
R.G. Hendry	22927		

☐ Additional registered practitioner(s) named on supplemental Registered Practitioner Information sheet PTO/SB/02C attached hereto.

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I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that wilful false statements and the like so made are punishable by fine or imprisonment, or both, under 18 U.S.C. 1001 and that such wilful false statements may jeopardize the validity of the application or any patent issued thereon.

Name of Sole or First Inventor: ☐ A petition has been filed for this unsigned inventor

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☐ Additional inventors are being named on the _____ supplemental Additional Inventor(s) sheet(s) PTO/SB/02A attached hereto